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THE BRAZILIAN BIODIESEL PROGRAM AND REGIONAL DEVELOPMENT: CASES FROM NORTHERN BRAZIL

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ABSTRACT

Biofuel production has been greatly discussed in Brazil. In 2004, these debates led the country to develop new policies and implement a national program for biodiesel use and production (PNPB) with the intent to increase the share of renewable energy and foster regional development. In this context, the present study aims to assess the impacts of PNPB on regional development in Tocantins State, northern Brazil. For this purpose, ranges of socio-economic indicators were collected among national and regional stakeholders, as well as specific literature. The preliminary results point out that distribution logistics appears to be a considerable constraint to the success of the PNPB. The concentration of biodiesel industries in the central-west region of the country, and the large distances to deliver biodiesel in the northern Brazil make biodiesel prices non-competitive when compared to fossil diesel. The results also suggest that the PNPB is not succeeding in promoting the integration of family agriculture in the Tocantins state, especially due to the structural difficulty of the agricultural sector, as well as the technical and political shortcomings presented by the mechanism of incentives.

Keywords: biodiesel; regional development; Tocantins state

1. Topic presentation

Global concern for the depredation and exhaustion of natural resources has led governments and scientists around the world to identify alternatives and solutions to the problem. Since the beginning of 21st century, an international debate has taken shape, which is currently discussed at 10 out of 10 meetings on sustainable development around the world: pros and cons of biofuels (Dubois,

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2008; FAO, 2008a; FAO, 2008c). From a socio-economic point of view, biofuels[3] can positively impact rural development and diversify the utilization of the local environment. For example, enhancing rural space multi-functionality, where farms are used not only for crop production, but also for eco and rural tourism (UN Energy, 2007; FAO, 2008b).

Based on this, in 2004 the Brazilian government launched a biodiesel program, National program of biodiesel use and production (PNPB), which was designed based on a scenario of high oil prices, a growing demand for fuels from renewable sources, and the country's comparative advantage in natural resources (Nass *et al.*, 2007). The PNPB is an Interdepartmental program of the Brazilian government with goals, such as, implementing production and use of biodiesel while focusing on social inclusion and regional development[4]. Moreover, the PNPB has several specific objectives: (i) implement a sustainable program, promoting social inclusion; (ii) guarantee competitive prices, quality and supply; (iii) produce biodiesel from different vegetable oil species[5].

In the present study, the Brazilian Program of biodiesel use and production (PNPB) is described. The rationality of the program and its implications to the economy, infra-structure, and job generation are assessed. In addition, the analysis of stakeholders involved, as well as geographical spatiality of the biodiesel companies and the oil production enables one to better comprehend the reality of this activity in Brazil. The Social Fuel Seal, which is an instrument of the PNPB, as well as the national auctions of biodiesel, are also analyzed aiming at enabling one to understand the role of national biodiesel production on the social inclusion, at macro level.

The study also focuses on the regional biodiesel production, on biodiesel companies and their structure, logistics, production and expectations related to the future. The regional analysis - which was carried out in Tocantins State in northern Brazil - is also important and essential to understand the drivers behind this new activity, as well as its impacts on regional and rural development in the Brazilian Amazon Region.

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[3] Biofuel essentially refers to liquid fuels derived from agricultural crops used for transport and energy generation (FAO, 2008b).

[4] According to Abramoway and Magalhães (2007), and Garcez and Vianna (2009), the biodiesel policy has the clear objective of promoting the social inclusion of family farming. This is a very commendable and much needed proposition, specifically in Brazil, aap country that has one of the worst distributions of land in the American continent and great disparities between the wealth of large, industrial-scale farming versus family-based counterparts.

[5] The PNPB has also a differential to other biodiesel programs created during the 1980's in Brazil, such as, the National program of vegetable oils to energy production (Pró-Óleo) and the Program of vegetable oils (OVEG). Apart from the production and use of biodiesel in the country, the PNPB focuses mainly on social inclusion and also takes into account the environmental aspects of biodiesel production. Due to importance of the social inclusion target, the national government established a range of different instruments aiming at fulfilling this target, such as, fiscal exemptions, financial subsidies, and specific credit lines to the biodiesel companies.

2. Biodiesel in Brazil

2.1 The Brazilian program of biodiesel use and production (PNPB)

In the year of 2003, a Brazilian inter-departmental group gathered to discuss and generate a report about the viability of biodiesel use as an alternative source of energy. As a result, a final report was designed and the results pinpointed some recommendations to the national government, such as the incorporation of biodiesel to the national agenda; and the adoption of social inclusion and regional development as guide principles for governmental actions. In addition, the report also recommended that the Brazilian agro-energy policy should not privilege technological routes (industrial process), raw/primary material (agricultural production), and neither industrial production scales[6]. All these recommendations were stated based on the wide range of available alternatives of vegetable oils in the country.

Since the institutional, as well as the organizational framework were implemented, and the biodiesel use and production in Brazil were established in the country, the first step was the elaboration and formulation of a regulatory landmark which was done according to the provisional executive order n. 214 on September 2004, which formally included the biodiesel as a corporate body in the national energy matrix. The same provisional executive order delegated competency and rights to the national agency of oil, gas and biofuels (ANP) to promote, regulate, authorize, hire and monitor the production, as well as the commercialization of biodiesel in Brazil (BRASIL, 2004). Once the inclusion of biodiesel as a corporate body in the national energy balance was done, the Brazilian government officially launched the Brazilian program of biodiesel use and production (PNBP) in December 2004.

So, one could observe that the PNPB was thought and built by different units of the Brazilian government. At the same time, the Program was based, at the macro level, on the international scenario of increased demand for renewable sources of energy, as well as on the Brazilian potential to fulfill this demand. At the micro level, the program sought to generate jobs and income in rural areas, mainly through the integration of family farmers into the biodiesel chain, and therefore the improvement of family agriculture living standard; and the decrease of regional disparities within the country[7]. In other words, the PNPB proposes a sustainable implementation of biodiesel production, focusing especially on the social inclusion and regional development, but considering the preservation of environmental and cultural aspects. The PNPB also enhances the importance of different vegetable oils, as sources of raw material to biodiesel production aiming at avoiding an overexploitation of few feedstocks, and also giving the opportunity to family farmers in several regions of the country to produce different raw material to the biodiesel industry.

[6] More details can be seen in GTI (2003).

[7] According to GTI (2003), Holanda (2003), and Yamaoka *et al.* (2003), the pure biodiesel (B100) produced from soybean, reduces 48% of carbon monoxide (CO), 67% of hydrocarbon (HC), 78% of carbon dioxide (CO_2), and 100% of sulfur oxide (SOx) compared to fossil diesel.

In summary, the PNPB has a crucial difference to other biodiesel programs created during the 1970's and 1980's in the country. Apart the production and use of biodiesel, the PNPB focuses mainly on social inclusion and also takes into account the environmental aspects of biodiesel production. Due to importance of the social inclusion goal, the national government established a range of different instruments aiming at fulfilling this target, such as fiscal exemptions, financial subsidies, specific credit lines and especially the Social Fuel Seal (SFS), which is described below.

2.2 The Social Fuel Seal (SFS)

Along with the official introduction and recognition of biodiesel as a corporate body in the national energy matrix, the Brazilian government also established the Social Fuel Seal (SFS) (decree n. 5.297, 12/06/2004). The SFS is a certificate given to biodiesel companies that purchase part of the raw material used to produce biodiesel from family farmers. According to the normative instruction n. 1, 02/19/2009, biodiesel companies should acquire a minimum of 10% of raw material from family agriculture in north and central-west regions[8], and a minimum of 30% of raw material from family agriculture in south, southeast and northeast regions of Brazil[9]. Moreover, the biodiesel company that purchases part of the raw material from family agriculture has also rights to taxes levied to biodiesel production (PIS/PASEP and COFINS)[10] established by the law n. 11.116 (05/18/ 2005). The biodiesel company that possesses the SFS also has facilities to obtain financial support from the national bank BNDES (national bank of economic and social development), for instance.

The SFS is monitored by the Brazilian ministry of agrarian development (MDA), and to obtain, as well as maintain the SFS, the biodiesel company must keep contracts with family farmers and guarantee, *ex ante*, market price or minimum price (average of last 36 months), selling and distribution conditions, and provision of seeds and technical assistance. In Tables 1 and 2, one can observe the taxation of biodiesel production in Brazil, as well as the differences between the biodiesel taxation and the taxation of gasoline, fossil diesel and ethanol, for example.

[8] Minimum of15% for the 2010/2011 harvest period onwards (MDA, 2010).

[9] According to MDA (2005), the percentage is estimated based on raw/primary acquisition costs from family agriculture compared to total acquisition annual costs. However, on the other hand, according to Garcez and Vianna (2009), there is no statistical explanation given for the mentioned percentages.

[10] PIS is the social integration program; PASEP is the public agent patrimony formation; and COFINS is the social security financing contribution. Both are implemented at national level.

Table 1: Taxation of biodiesel in Brazil

Primary/raw Material	Region	Type of agriculture	PIS/PASEP (R$/m³)	COFINS (R$/ m³)	Total federal tax (R$/ m³ biodiesel)
Any	S; SE, CE	Any	31.75	146.20	177.95
Castor; palm	N; NE; Sar	Any	27.03	124.47	151.50
Any	S; SE, CE	Family	12.49	57.53	70.02*
Any	N; NE; Sar	Family	0.00	0.00	0.00*

Source: Garcez and Vianna (2009).

Note: * refers to those companies that possess the SFS.

N = north; NE = northeast, S = south; SE = southeast; CW = central-west; Sar = semi-arid.

As one can notice, the biodiesel produced from raw material cultivated by family farmers in the north, northeast and semi-arid regions of the country has no incidence of taxation (taxation is equal to zero), followed by biodiesel produced from raw material cultivated by family farmers in the other regions of Brazil, which has a taxation around R$70.00 per m³ of biodiesel. The lower taxation or even the lack of taxation of biodiesel that has been produced from raw material cultivated by family farmers is supported by the social inclusion target of the PNPB. In addition, the lower taxation of biodiesel produced in the north, northeast and semi-arid regions are related to the fact that these regions are considered the poorest regions of the country. Since 2004, the gross domestic product (GDP) per capita of the northeast region was approximately half to the national average, while in the northern region it was around 35% lesser than the national average (HOLANDA, 2003).

As one could also notice in the Table 1, whenever the biodiesel is produced with no participation of family agriculture, the taxation increases. Indeed, the objective of the Brazilian government is to encourage biodiesel production in the northern Brazil (region characterized mainly by the Amazon rain forest and Cerrado biomes), and in the northeast of the country (region that comprises Cerrado and Atlantic forest biomes), especially through the production of *Ricinus communis* and *Elaeis guineensis* (dendê) (Garcez and Vianna, 2009). As one could observe, the same incentives do not apply to soybean cultivated in these regions of the country. Even so, the taxation of biodiesel is lower than the taxation of gasoline and fossil diesel, and somewhat similar to ethanol, which has also tax exemptions for being considered a renewable source of energy, like biodiesel.

Table 2: Taxation of gasoline, diesel and ethanol in Brazil

Taxation	Gasoline (R$/ m³)	Diesel (R$/ m³)	Ethanol (R$/ m³)	
			Import/producer	Distributor
CIDE*	280.00	70.00	0.00	0.00
PIS/PASEP	46.58	26.36	23.38	58.45
COFINS	215.02	121.64	107.52	268.80
Total (R$/m³)	541.60	218.00	103.90	277.25

Source: Garcez and Vianna (2009).

Note: * economic domain intervention.

As one observes in Table 2, the total taxation (CIDE + PIS/PASEP + COFINS) is higher for gasoline and diesel, even when compared to taxation of biodiesel not produced from raw material cultivated by family farmers (above all, the PNPB aims to foster renewable sources of energy in the country). One can also notice that the taxation of ethanol (for import/producers) has similar taxation compared to biodiesel. It is interesting that apart from the fact that the rules and norms for production of both renewable fuels are embedded in different national programs (ethanol production is based on the Programa Nacional do Álcool, so-called Pró-Álcool), the taxations have similar trend, and in other words, both renewable fuels have tax exemptions when compared to their fossil counterparts.

2.3 National biodiesel auctions

After the biodiesel compulsory market conceived by the law n. 11.097/2005, and aiming at regulating the biodiesel commercialization in the country, the Ministry of mines and energy (MME) established the guidelines for national auctions of biodiesel acquisition (presidential order n. 483, 10/03/2005). In this context, the national auction was conceived as a mechanism to include a new renewable fuel in the national energy matrix; and solve numerous problems of provision, logistics and distribution.

Based on this, the national auction is framed on a public tender organized by ANP, and it is separated into 2 phases: (a) the first comprises 80% of total biodiesel commercialized and is devoted to those companies that possess the SFS; and (b) the second phase comprises the remaining 20% of biodiesel, and all biodiesel companies can join it, i.e. those that possess and those that do not possess the SFS. For each auction is provided: a notice which inform about the biodiesel acquisition volume and delivery, as well as participation conditions; the producer accreditation; the electronic remittance of price proposal, i.e. the ANP presents a maximum price per unit of biodiesel, *ex ante*, which is the benchmark for the producers' bids during the auction. Thus, the biodiesel companies have the opportunity to submit a proposal that may consist of up to three individual prices[11], also specifying the quantity of biodiesel and the location where the product may be delivered (Garcez and Vianna, 2009). The company that presents the lower price for the respective volume of biodiesel is the winner and thus is the responsible to produce the renewable fuel within the timeframe established by ANP.

It is important to say that, so far, the Petrobras is the only biodiesel purchaser during the national auctions, therefore characterizing a condition of pure monopsony[12]. After the biodiesel has been purchased, Petrobras allows distributors to pick it up *in loco*, i.e. in the industries. The entire biodiesel sold at

[11] The ANP and the national government are willing to change the three-proposal price submission to only two-proposal price submission in 2010 (BIODIESELBR, 2009).

[12] In economics, a monopsony is a market form in which only one buyer faces many sellers (Varian, 2006).

national auctions is considered "free on board" (FOB), which means that distributors should carry the responsibility for freight costs. Then, the blend of biodiesel with diesel is made by the fuel distributors, but the refineries are also allowed to make it and deliver the B's (at the moment the B5) to the distributors.

Another important issue regarding the biodiesel commercialization is that the renewable fuel must fit into technical specification norms released by ANP. The biodiesel producers when commercializing their final product should present, *ex post*, the quality certificate in accordance to the national specification of quality. In summary, one can notice that the Brazilian government seeks to adopt different norms and rules about the implementation of PNPB. This is justified by the fact that Brazil has faced several problems and constraints with all the other biofuels programs during the 1970's, 1980's and 1990's, especially regarding the agricultural production, regional disparities and social exclusion. However, as one might see in the next section, the PNPB also faces problems, especially regarding the diversification and supply of raw/primary material.

2.4 Biodiesel commercialization

After the provisional executive order n. 214 (09/13/2004), ANP started a public consultancy aiming at establishing the technical specifications regarding the percentages of biodiesel blend into fossil diesel. At that time, ANP reached a consensus that a voluntary biodiesel blend of 2% into fossil diesel, the so-called B2, was appropriate to start the program. However, when the provisional executive order became a law (law n. 11.097, 01/13/2005), the national government chose the mandatory blend rather than the voluntary one. It is important to say that the blend percentage, as well as the timeframe involved on the process can be changed anytime according to availability of raw material, industrial capacity, and the share of family agriculture in the biodiesel chain. In this context, the national government established that before the year of 2008, all entire biodiesel could, voluntarily, contain 2% of biodiesel, which turned into mandatory in January 2008. According to Garcez and Vianna (2009), the reason for leaving the mixture optional rather than mandatory at the beginning was the possibility of participating in the Clean Development Mechanism (CDM) of the Kyoto Protocol, through the generation of carbon credits. Yet in the year of 2008, the percentage shifted to 3% (B3), to 4% (B4) in 2009, and finally reached 5% (B5) in 2010[13], as one can see in the Figure 1.

[13] There is an ongoing debate within national government about the establishment of B20 in metropolitan regions of the country (BIODIESELBR, 2010).

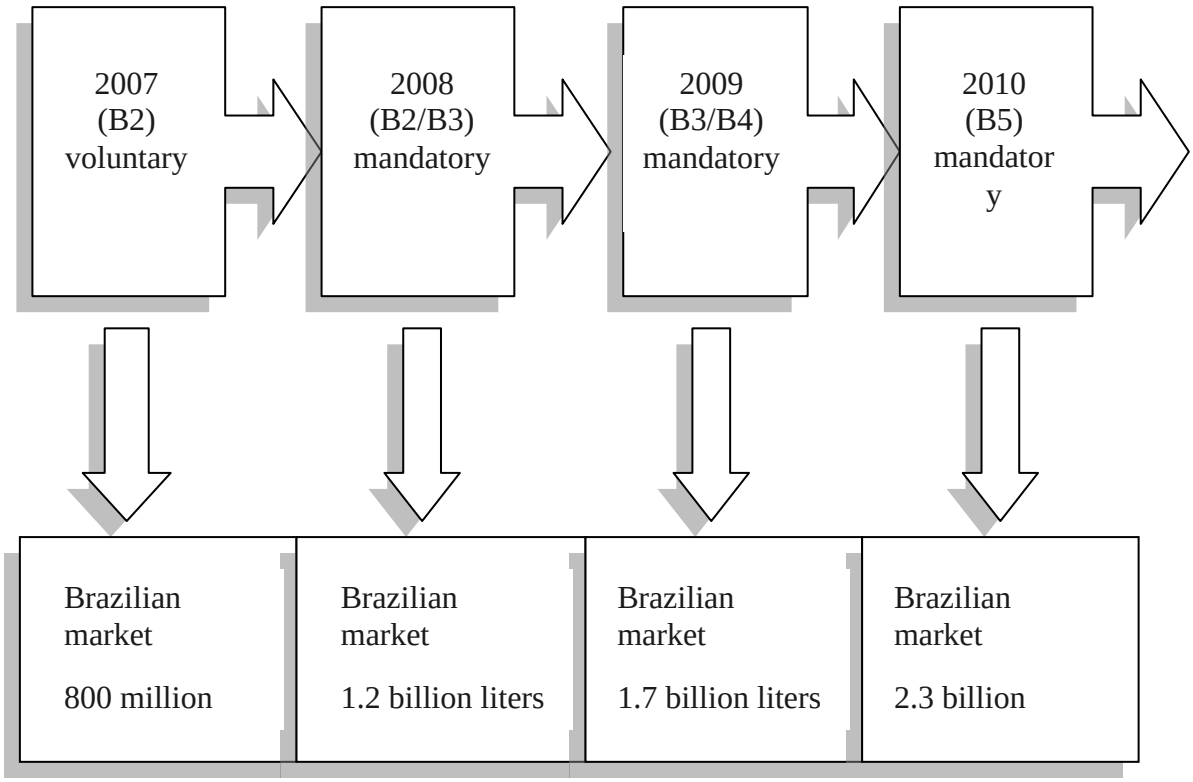


Figure 1: Biodiesel mixtures (B's) and its impacts on market

Source: ANP (2010).

Note: * expectative.

As one observes in the Figure 1, according to the B2 in the year of 2007, there was a demand of roughly 800 million liters of biodiesel, a volume that might reach 2.3 billion liters of biodiesel in 2010 with the B5. The economic impacts throughout the country are somewhat clear especially on the national balance of payments, since the country is diminishing the import of fossil diesel. However the impacts on social and environmental sectors are unclear, once the major part of biodiesel production is made from soybean produced by large-scale farms.

3. Biodiesel in Brazil: current situation

This section aims to present the panorama of the Brazilian biodiesel industry, as well as the current national biodiesel scenario. After 6 years of the PNPB implementation, some results at macro/national level are perceptible, especially those related to the production and commercialization sectors. Based on this, the real capacity, as well as the potential production of biodiesel is analysed. In addition, the spatial localization of biodiesel industries and the installed capacity of these industries are also assessed, enabling one to have a broader picture of the biodiesel production and commercialization in Brazil, and thus to estimate the impacts on social inclusion and jobs generation, at the macro level.

3.1 Biodiesel industries and commercialization

In the year 2009, there were 64 industries authorized by ANP to produce biodiesel in the country, and of those, 49 industries were authorized to commercialize biodiesel in Brazil[14]. Based on this, the total installed capacity in the year 2009 was estimated in 4,628 million m^3 per year, which is equivalent to roughly 50% of the demand needed for the 5% blend of biodiesel into fossil diesel, the so-called B5 (around 2.6 million of m^3).

Table 3: Biodiesel production capacity installed in Brazil (2009)

Region	Productive units	Annual capacity (thousand 10^3 m^3/year)*	% of total
S	7	931	20.1
SE	14	1,778	38.4
N	6	185	4
NE	8	803	17.4
CW	29	931	20.1
Total	64	4,628	100

Source: ANP (2010).

Note: * Based on 300 days/year.

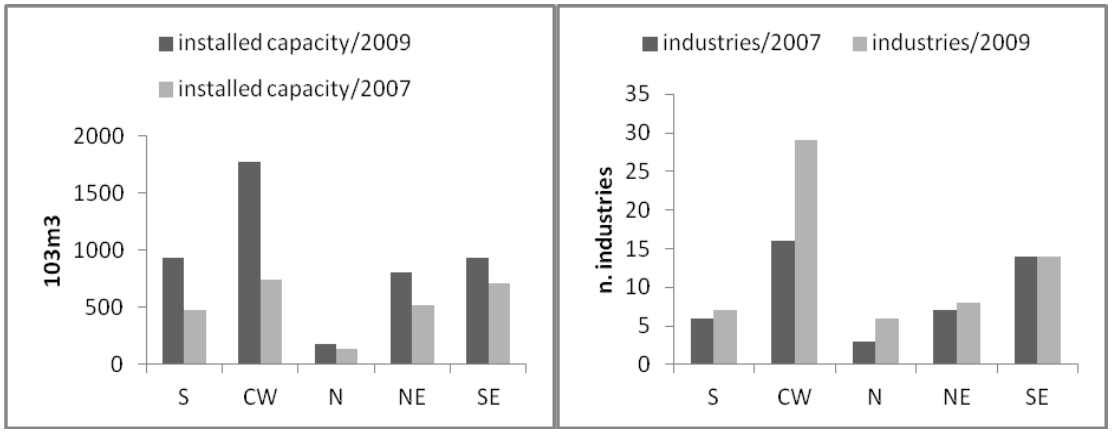
S=south; SE=southeast; N=north; NE=northeast; CW=central-west.

As one can see in Table 3, there is a concentration of biodiesel industries in the central-west and southeast regions of Brazil (29 and 14 industries, respectively). This picture reflects the current situation of spatial localization of production units, which are closer to farm oil seeds units in the case of the central-west region, and closer to distribution units in the case of the southeast region. However, when one considers the annual capacity of biodiesel production, the southeast is far the region that presents the highest volume: roughly 1,780 billion of liters per year. The south region, although it comprises only 7 biodiesel industries, is responsible for 20.1% of the total annual production capacity, the same amount as in the central-west region, for example. This figure shows that the production units in the south region are larger than those installed in the central-west region, on average.

When one considers the longitudinal data, one is assured that there is a concentration of biodiesel production capacity in the central-west region of Brazil. Not just the annual capacity but also the absolute number of production units increased tremendously in this region during the period between 2007 and 2009, compared to other regions in the country. One of the most reasonable explanations for this trend is the fact that this region is responsible for the major part of the agribusiness in the country, especially from soybeans, which may have a strong impact on decisions about the spatial location of the biodiesel industries in the country, since soybean is the most used oil to produce biodiesel in Brazil. Thus,

[14] There are also 19 industries authorized by ANP to be constructed, or to enlarge their current capacity of biodiesel production (ANP, 2010). Even so, it is important to say that the majority of biodiesel industries in Brazil operate, on average, with less than 50% of their production capacity.

the information contained in Table 3 is corroborated by the Figure 2, where the north region is responsible for the lower number of industries, as well as the lowest biodiesel production capacity, although this region is the largest region in Brazil (in territory) and one of the poorest regions of the country, regarding GDP, for instance (Finco, Rodrigues and Rodrigues, 2006). Therefore, one important thing based on the concentration of biodiesel industries in the country should be highlighted, *ex ante*: since the north and northeast regions are those considered the poorest regions of the country, the concentration of biodiesel sector in the south, southeast and especially in the central-west regions of Brazil might jeopardize one of the PNPB's target, namely the decrease on regional disparities.



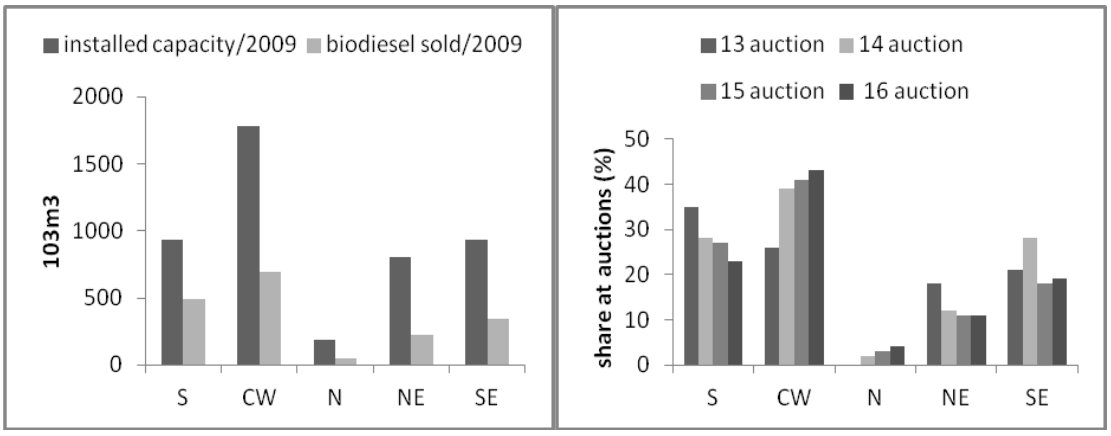
(a) (b)

Figure 2: **(a)** Installed biodiesel production capacity; and **(b)** number of biodiesel industries in Brazil

Source: ANP (2010).

Notes: S=south; SE=southeast; N=north; NE=northeast; CW=central-west.

Another interesting issue regarding the production and commercialization of biodiesel in Brazil is that the current production capacity in the country is much higher than the biodiesel commercialized at national auctions. As one can observe in Figure 3, the capacity in 2009 is considerably higher than the biodiesel sold at national auctions in the same year. According to outcomes from national auctions 13, 14, 15 and 16, occurred in the year of 2009, roughly 1,810 billion of liters of biodiesel were sold out. During the same period, the biodiesel production capacity installed in Brazil was 4,628 billion liters, i.e. more than twofold the biodiesel commercialized in the country.



(a) (b)

Figure 3: (a) Installed capacity vis-à-vis the biodiesel sold out at national auctions (2009); and **(b)** the share of regions according to biodiesel sold out at national auctions (2009)

Source: ANP (2010).

Notes: S=south; SE=southeast; N=north; NE=northeast; CW=central-west.

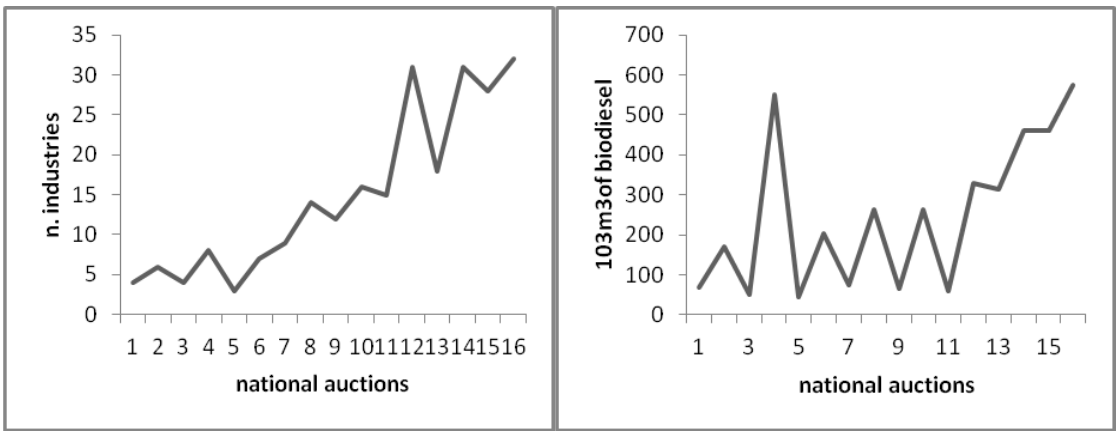
As one can notice in Figure 3b, there is a decrease in the share from the south and northeast regions in the national auctions, as well as an absolute increase in the share from the central-west region. This scenario goes hand in hand with figures presented previously, and therefore enhances the concentration of industries, industrial capacity and production of biodiesel in the central-west region of Brazil. The south and the northeast region also present decreased participation at national auctions. The north region is slowly increasing its participation as a biodiesel seller at national biodiesel auctions.

3.2 Results of national biodiesel auctions

National biodiesel auctions, as described previously, have occurred since 2005. The main objective of auctions is generating a market, and thus to stimulates biodiesel production in sufficient quantity that enables refineries and distributors to have the necessary biodiesel blended with fossil diesel. Based on this, the biodiesel national auctions persists on aiming at assuring that all fossil diesel commercialized within the country has the percentage of biodiesel established by the national law.

In this context, by the end of 2009, 16 biodiesel auctions were carried out by ANP. Around 5 industries participated in the first auction in 2005, and more than 30 industries sold production during the 16th auction in November 2009. The volume of biodiesel sold at national auctions also increased. Before the 5th auction, the blending of biodiesel into fossil diesel was not mandatory, and thus auctions were carried out to maintain national stocks of biodiesel. However, from 2008 onwards the biodiesel became mandatory, and the entire fossil diesel commercialized in the country had to contain a certain percentage of biodiesel. The monetary amount reached R$1.3 billion during the last auction (16th),

reflecting therefore the economic importance of the biodiesel sector in Brazil. The participation in the first five auctions was conditioned to the SFS possession, i.e. only companies that had the SFS, at that time, could join the auctions. The peaks between the first and auction number 11 are explained by the fact that in one single auction, only SFS owners could participate, and in the following auction all companies (even those who do not possess the SFS) could join. However, from the 12th auction onwards the same auction was separated in two phases: the first comprising only SFS owners and a second phase where all companies could participate. Therefore, as one can observe in Figure 4b, no more extreme peaks occurred at national auctions.



(a) (b)

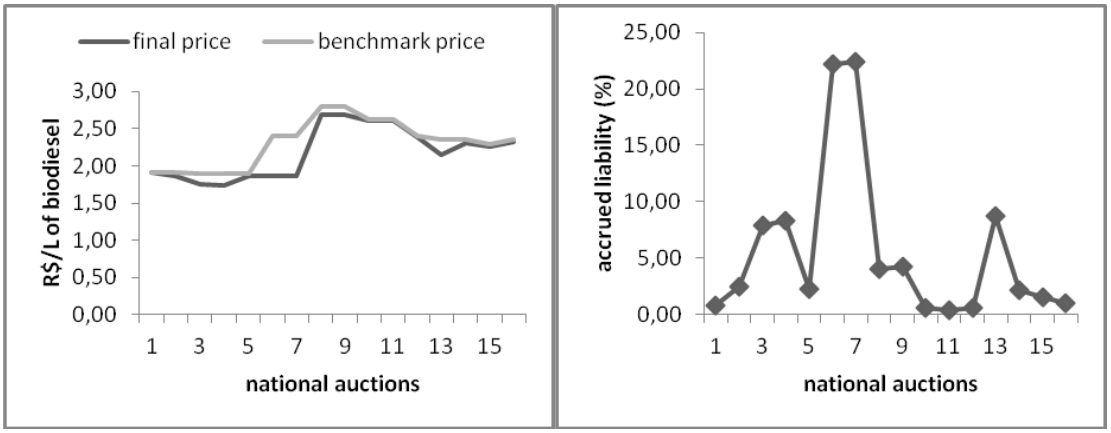
Figure 4: (a) Number of companies that sold biodiesel at national auctions; and **(b)** volume of biodiesel commercialized during national auctions

Source: ANP (2010).

Moreover, as one can see in Figure 4, there is a clear trend in the number of industries that sell biodiesel at national auctions. Some volatility can be seen in the volume of biodiesel commercialized during the auctions, which can be explained, at least in part, by the benchmark/reference price established by ANP vis-à-vis the price of the vegetable oil. Regarding the price of biodiesel at national auctions, one should bear in mind that ANP fix, *ex ante*, a maximum price which is the reference price for the producers' bids during the auction. So, before each auction, the ANP together with Ministry of Mines and Energy (MME), and Ministry of Agrarian Development (MDA), define the benchmark price which is established based on seed costs (soybean is normally used), the extraction, as well as distribution costs. According to ANP, the reference price is usually higher than the market price, since the biodiesel delivery is taken into account.

Based on this, Figure 5 demonstrates the volatility of the final price of biodiesel sold out at national auctions. As one observes, the price has increased especially between the 5th and 10th auction (mostly in the year 2008) which is, at least in part, explained by the boost in the price of soybean oil. Since the costs with raw/primary material account for roughly 80% of the total production costs, the biodiesel price follows the trajectory of the oil seed price. As soybean is the

main vegetable oil used to produce biodiesel in Brazil, the price of this vegetable oil leads the price of biodiesel in the country, which ranged from R$2.00 up to R$3.00 per liter of biodiesel during the years of 2005 and 2009. It is important to say both PIS/COFINS taxation are included in the reference price established, *a priori*, by the ANP.



(a) (b)

Figure 5: (a) Selling price of biodiesel at national biodiesel auctions; and **(b)** price discounts at national biodiesel auctions

Source: ANP (2010).

The discount, which refers to the difference between the benchmark prices (reference prices) established by ANP, *ex ante*, and the final price of biodiesel sold out, is extremely volatile and reached the figure of 22% during the 6th ad 7th auctions in 2007. The higher the difference in the discount, the more aggressive the industry strategy aiming at guaranteeing its biodiesel commercialization is. However, the relationship between reference price, strategies, and market price of soybean oil has impacts on biodiesel production, since there is still a small rate of default from the industry side, i.e. some industries after selling out of a specific volume of biodiesel during the auction, did not deliver the fuel within the timeframe previously established. Some explanations for the default can be linked to the low agricultural productivity; and the non-contract accomplishment from the farmers' side that prefers to sell the production to chemical-pharmacy industries, for instance.

Nevertheless, an important issue that can be observed at national auctions is that the agricultural sector is constantly ignored, especially regarding the family agriculture production. The volume of biodiesel in all national auctions is related solely to biodiesel industrial capacity of companies, and thus do not take into account the production capacity of the agricultural sector. In other words, the capacity of the family agriculture in supplying the needed raw/primary material aiming at fulfilling the negotiated volume of biodiesel (according to the targets established by the PNPB) is not considered by the other stake-holders. In this context, one can clearly see that among the vegetable oil species, soybean is responsible for roughly 80% of the national biodiesel production, whereas *Ricinus*

communis, *Jatropha curcas*, as well as other vegetable oil species that can be cultivated by family farmers are responsible, in aggregate, for less than 10% of the national biodiesel production. If one considers the last 4 years of biodiesel production in Brazil, for instance, soybean appears as the main source of vegetable oil (80% on average), followed by animal fat (roughly 10% on average) and other species (10% on average).

Considering that the PNPB stated that at least 30% of raw/primary material should come from family agriculture in the south, southeast and northeast regions of the country, and a minimum of 10% of raw/primary material should come from family agriculture in north and central-west regions of Brazil, one can realize that at the macro/national level the PNPB is not fulfilling one of its main targets namely the promotion of social inclusion. Since soybean is the main vegetable oil used to produce biodiesel, and normally is cultivated by large-scale farmers, the PNPB is far away from being successful regarding the diversification of raw/primary material used to produce biodiesel.

Alternative crops such as *Ricinus communis* still have a symbolic share in national biodiesel production, with participation lower than 2%. *Jatropha curcas* and *Elaeis guineensis* (dendê) can also be used as alternative vegetable oil towards the national biodiesel production. However, so far, *Jatropha* does not present a production scale. In the case of dendê, the energy density is high enough to give profitability without fiscal public policies or subsidies, but there is an imperious risk of Amazon rain forest deforestation.

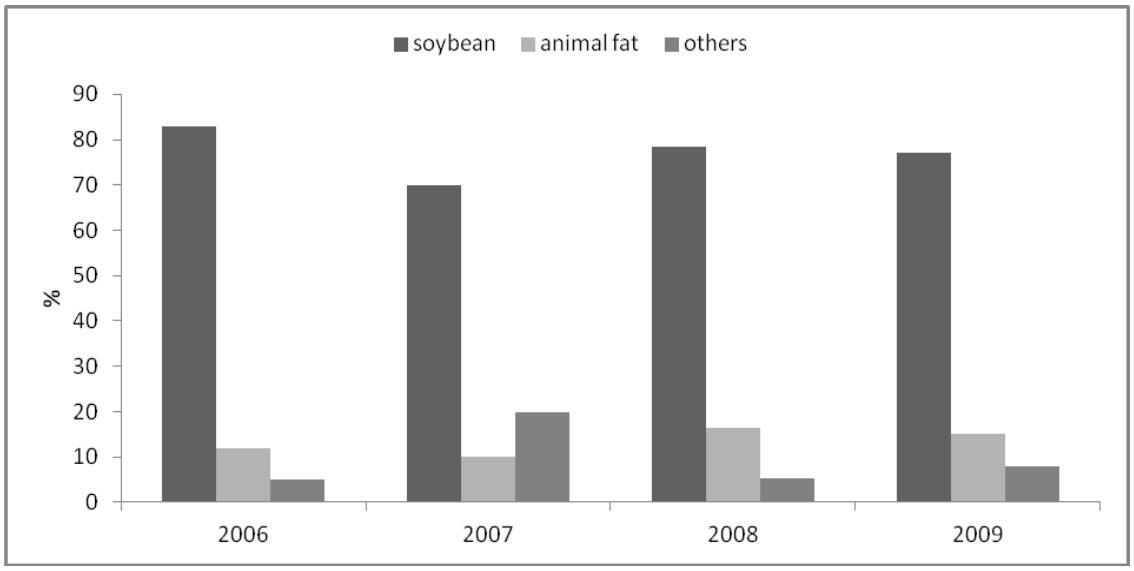


Figure 6: Share of raw/primary material in the Brazilian biodiesel production

Note: *expectative.

Source: ANP (2010).

Therefore, considering that the volume of biodiesel sold at national auctions in 2009 reached the volume of 1,810 billion of liters, one can be assured that around 1,448 billion of liters were produced from soybean oil, 181 million of liters were produced from animal fat, and around 181 million of liters of biodiesel were produced from other sources, such as *Ricinus communis*, for instance. Herein, all the other sources are represented by *Ricinus communis*, since according to the national government *Ricinus* is the main small-scale vegetable oil advocated by the PNPB (PNPB, 2005). So, 181 million liters of biodiesel produced from *Ricinus communis* requires around 450 thousand tones of *Ricinus*, which would occupy an area between 300 and 900 thousands of hectares, depending on the feedstock productivity. As *Ricinus* occupied an area of 156 thousand of hectares in 2008 (BIODIESELBR, 2009), and has a production estimated on 120 thousands of tones, on average (FAOSTAT, 2009), *Ricinus communis* reached a productivity of 769 kg per hectare, on average, in the year of 2008. Thus, based on this productivity, around 580 thousands of hectares are needed to cultivate *Ricinus communis* aiming at fulfilling the PNPB targets, and therefore promoting the social inclusion, which is virtually improbable to occur.

The situation involving the *Ricinus communis* in the northern region, which most probably will affect the regional biodiesel companies in the middle and long run reflects the choices made by the national government on the selection of only one small-scale vegetable oil specie towards the biodiesel production. Moreover, according to MDA, Brazil has at the moment around 80,000 family farmers involved in biodiesel production. This figure is considerably lower than the 200,000 family farmers predicted by the Brazilian government at the beginning of 2005. In this context, one could observe that at the macro/national level the PNPB is not being effective in promoting social inclusion.

4. Regional analysis: biodiesel production in Tocantins State

During the year 2009, Tocantins state was considered the 8th biggest biodiesel producer in Brazil. In addition, regarding the production capacity authorized by ANP, the state of Tocantins was ranked in the 7th position in the country in 2009, with more than 385m^3/day. To have an idea of comparison, for example, the 1st state ranked regarding the authorized production capacity during the year of 2009 was Mato Grosso, located in the central-west region of Brazil, which was responsible for more than 2500 m^3/day of production capacity. Thus, this section seeks to analyze the biodiesel production in Tocantins state, in northern Brazil. At the time the research was carried out (year of 2008) only two biodiesel companies were installed in the state, namely Brasil Ecodiesel, and Biotins Energia. Both of them sell biodiesel at national auctions, regularly, and both keep contracts with family farmers aiming at maintaining the Social Fuel Seal.

4.1 Brasil Ecodiesel Company

Brasil Ecodiesel can be considered the pioneer in large-scale biodiesel production in Brazil. The company has production units spread in different regions throughout the country, and was one of the first companies in Brazil to obtain the Social Fuel Seal (SFS). The company also participated in all biodiesel national auctions since 2005, and was considered the biggest biodiesel producer in Brazil until the year of 2007, responsible for more than 50% of national production. The company operates 3 units of vegetable oil extraction in different regions of the country, and possesses 6 transesterification production units, including the unit of the city of Porto Nacional, handled in the present study.

Inaugurated in 2007 in the city of Porto Nacional, the Brasil Ecodiesel unit located in this city has more than 3700 m^2 of constructed area, and a production capacity of 118 thousands m^3/year (ANP, 2010). The unit has around 130 employees, which implies a payment of more than R$130 thousands (salary and charges), monthly. In the year of 2009, the company invested around R$1 million to construct a laboratory of biodiesel certification aiming at diminishing operational costs, since the previous biodiesel analysis were made in the unit of Brasil Ecodiesel located in the Ceara state, more than 1000 km far away from the city of Porto Nacional. Due to the implementation of the B5 in 2010, one should expect that the unit of Brasil Ecodiesel in Porto Nacional will increase the biodiesel production from 9 thousands m^3/month to 18 thousands m^3/month. The company may double its production without any kind of extra investment, since the unit was operating at idle capacity. Brasil Ecodiesel in Porto Nacional keeps annual contracts with family farmers that produce *Ricinus communis*, and with large-scale farmers that produce *Helianthus annus* in Tocantins state. Nevertheless, the company uses soybean oil acquired from other places in the country to produce biodiesel, which leads to an increase in the logistics and tributary costs of the biodiesel produced by the unit of Porto Nacional.

4.2 Biotins Energia Company

Inaugurated during the year of 2007 in the city of Paraiso do Tocantins under an investment of R$6 million, the Biotins company is considered as a pioneer in the country regarding the production of *Jatropha curcas* at large-scale level. The company operates regularly since 2008, but the biodiesel is still produced from a mix of different raw/primary material, which includes soybean oil and animal fat. In January 2010, the ANP authorized the company to amplify its production capacity, from 800m^3/month to 2400 m^3/month, which required an investment of around R$7 million. The expectation is that Biotins expands fivefold the production capacity until 2011, when the *Jatropha* plantations will be in the productive cycle (4th year). Moreover, *Jatropha* is expected to be responsible for 50% of the total raw/primary material used by the company to produce biodiesel.

Biotins uses a modular unit to produce biodiesel, which is compact and requires little amounts of labor. The first modular unit was bought in 2007, and the second and third modular units were bought in the year of 2009, under an investment of more than R$15 million. The next investment expected in the year of 2010 is an oil extraction unit, since the company is looking forward to producing around 27million of liters of biodiesel in the year of 2010, and around 50 million of liters of biodiesel in the year of 2011. At the moment the research was carried out (year of 2008), Biotins had around 40 employees, which represents a monthly payment of more than R$ 90 thousands, including salary and charges. Biotins Energia also keeps a ten-year contract with family farmers that produce *Jatropha curcas* in Tocantins state. The contracts are based on purchase conditions guarantees, technical assistance, as well as pre-fixed price for the ton of raw material, which is revised annually according to nation-wide index of consumer prices (IPCA). Although the company does not possess the social fuel seal (SFS), all the contracts with family farmers were made following the norms and requisites of SFS, dictated by the MDA.

4.3 Regional biodiesel production and the PNPB

Tocantins state was responsible for more than 38,580 millions liters of biodiesel sold at national auctions during the year of 2009. From those, Brasil Ecodiesel was responsible for 34 millions of liters, and Biotins was responsible for 4.5 millions of liters of biodiesel (Figure 7).

Tocantins state is situated in the northern Brazil, and thus biodiesel industries, located in the state, that aim to produce and sell biodiesel at national auctions, should follow the SFS norms, and therefore should use at least 10% of the raw/primary material from family agriculture. Based on this, Brasil Ecodiesel should produce at least 3.4 million liters of biodiesel from raw/primary material cultivated by family farmers. This scenario demands around 6.6 thousand tones of castor berries. Considering that the productivity of *Ricinus* ranges from 0.5 and 1.5 ton/ha, between 13.3 thousands and 4.4 thousands of hectares, respectively, are needed in Tocantins state to fulfill the 10% company demand of raw/primary material from family agriculture. In addition, taking into account that the productivity of castor production in the region was 127kg per hectare (data from the survey carried out in 2008), on average, more than 52 thousand hectares are needed to cultivate *Ricinus* aiming at fulfilling the company demand for raw/primary material from family agriculture. Therefore considering that nowadays only around 600 hectares are cultivated with castor by family farmers in the Tocantins state, one can conclude that it is highly improbable that Brasil Ecodiesel fulfill the condition of 10% raw/primary material from family agriculture. This real scenario suggests that, at regional level, the company is not supporting the PNPB towards the accomplishment of the social inclusion target.

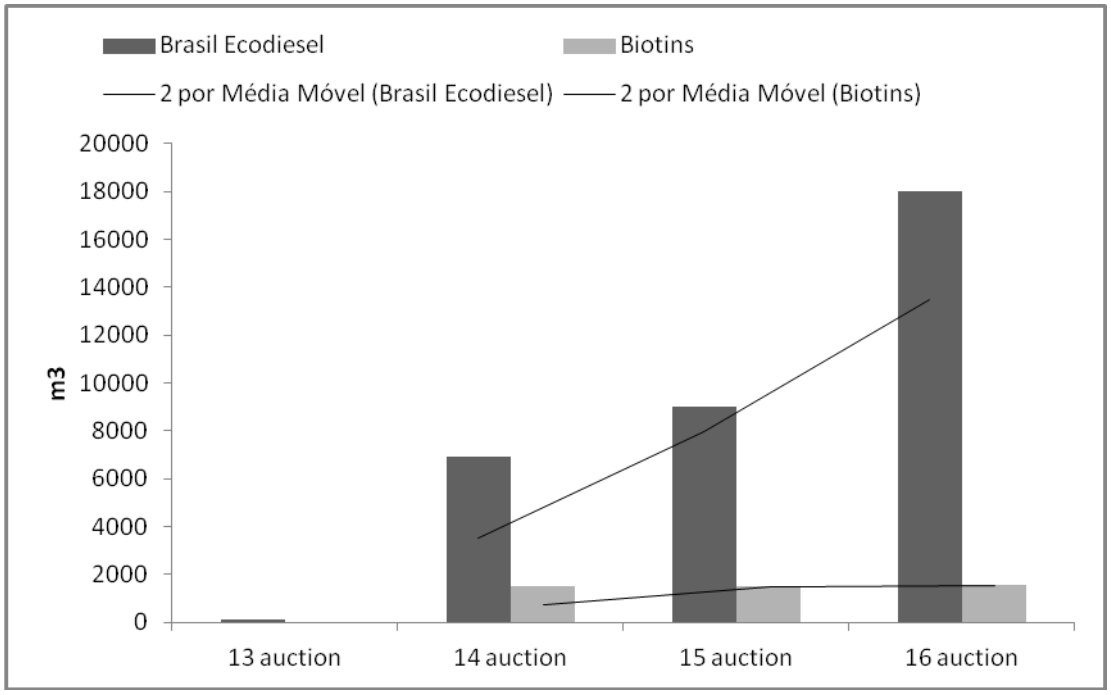


Figure 7: Biodiesel sold out at national auctions (2009)

Source: ANP (2010).

A similar trend can be noticed in the case of Biotins Energia. Considering the share of Biotins during the national auctions in the year of 2009, Biotins should produce at least 450 thousand liters of biodiesel from raw/primary material cultivated by family farmers. This scenario demands more than 12.6 thousand tones of *Jatropha* seeds. Considering that the productivity of *Jatropha* ranges from 2 up to 12 tons per hectare, between 6 thousand and 1 thousand of hectares is needed, respectively, in Tocantins state to fulfill the 10% company demand of raw/primary material produced by family agriculture.

However, taking into account that most part of small-scale famers that keep contracts with Biotins started the activity in the year of 2007, an estimate of the productivity of *Jatropha* in the second year (2009) was made, and thus three different scenarios were established: (i) the first scenario (or current scenario) reflects the productivity of the second year following the low productivity of the first year (2008), which was extremely low especially due to natural conditions; (ii) the second scenario (or regular scenario) reflects that the productivity can be considered the minimum productivity expected by the company in the region and; (iii) the third scenario (or optimist scenario) is based on the ratio between the best productivity reached in the first-year-cycle of the *Jatropha* in the region and the minimum expected by the company.

Table 4: *Jatropha curcas* productivity scenarios in Tocantins state

Harvest/ Year	Productivity scenario (kg of seeds/ha)		
	Current (pessimist)	Regular	Optimist
1 year (2008)	42	42	42
2 year	542	1280	1822
3 year	890	2100	2990
4 year onwards	1272	3000	4273

Source: research results (2010).

So, considering the current scenario, the productivity in the second year (2009) lies around 542 kg, on average per hectare, against 1280 kg on average per hectare in the regular scenario, and 1822 kg on average per hectare in the optimist scenario[15]. Based on this, aiming at fulfilling the 10% demand of raw/primary material from family agriculture, more than 23 thousand hectares are needed to cultivate *Jatropha* in the first scenario, more than 9 thousand hectares are needed in the second scenario, and more than 6 thousand hectares are needed to cultivate *Jatropha* in the third scenario. Considering that nowadays, only around 500 hectares are being cultivated with *Jatropha* by small-scale farmers in Tocantins state, one can be assure that Biotins cannot fulfill the 10% demand of biodiesel produced with raw/primary material from family agriculture. Even though the productivity of *Jatropha* increases in the following cycle years, as one can see in Table 4, the quantity of hectares needed might also increase, since the production capacity of the company will also be improved. So, as one could observe, both companies, at regional level, did not support the Brazilian program of biodiesel use and production (PNPB) towards the accomplishment of the social inclusion target[15].

Roughly 80% of the national biodiesel production is made using soybean oil. So, following the national trend, Tocantins state is responsible for producing 27.2 millions of liters of biodiesel from soybean oil, in the case of Brasil Ecodiesel, and 3.6 millions of liters of biodiesel from soybean oil, in the case of Biotins. So, the total volume of biodiesel produced from soybean oil in Tocantins amounts to over 30.8 millions of liters. This situation demands more than 159 thousand tons of the grain, which requires between 79 thousand hectares and 53 thousand hectares, considering the productivity of 2 and 3 tons per hectare, respectively. Considering that soybean in Tocantins state occupies an area of around 344 thousand hectares, and was responsible for more than 665 thousand tons of grain in 2008 (SEAGRO, 2009), i.e. productivity around 2 ton/ha, one can be assured

[15] In addition, the fossil diesel consumption in Tocantins state during the year of 2009 was around 576 thousands m3 (ANP, 2010). Thus, according to the 4% mandatory blend of biodiesel into diesel (B4) during the year of 2009, roughly 23 thousands m^3 of biodiesel were needed to be produced in the Tocantins state aiming at fulfilling the B4 norms. Therefore, from those 23 thousands m^3, 10% should be produced from raw/material cultivated by family agriculture, i.e. 2,306 m^3. In fact, as one could see, biodiesel companies in Tocantins state, Brasil Ecodiesel and Biotins Energia, sold around 38,580 m^3 of biodiesel in 2009, i.e. the state achieved its goal regarding the B4. Nevertheless the state did not fulfill the PNPB target of social inclusion, since both biodiesel companies did not produce biodiesel from raw/material cultivated by the family agriculture. Brasil Ecodiesel used soybean and sunflower, both produced by large-scale farmers, and Biotins used soybean and animal fat, both also produced by large-scale farmers.

that the volume of soybean grain produced in the state is more than enough to supply raw/primary material to biodiesel companies towards the biodiesel production.

4.4 Logistics

Another obstacle to biodiesel production is related to the logistics, especially regarding the raw/primary material and inputs supply, as well as the distribution of products and by-products throughout the state. Therefore, storage and transport can be considered the main obstacles in the northern region of the country, mainly due to the lack of governmental assistance, as well as geographic issues, such as the spatial dispersion of family farmers, and the technical characteristics of the raw/primary material like *Ricinus*, for instance. These characteristics might, in some cases, jeopardize the entire biodiesel production in this part of the country.

In this context, aiming at overcoming these problems, the biodiesel sector in northern Brazil should seek to gather raw/primary material from family agriculture as fast as possible to reduce the movement costs, and at the same time to avoid chemical alters in the raw material. So, the challenge to any industry responsible for raw/primary material movements in this region is related to how overcome the spatial dispersion of family agriculture production. In the case of the Biotins, for instance, the city of Paraiso do Tocantins is located around 68 km away from Palmas (west), the capital of Tocantins state. The production unit is situated at the margins of the BR 153 road (Belem-Brasilia), which is the main federal road in the state, and therefore facilitates the flow of inputs, products and by-products. Biotins Energia is also situated in the margins of the north-south rail road, which links the south to the north of the country (expected to be finalized by 2011). A similar situation is observed in the case of Brasil Ecodiesel. The production unit is located in the city of Porto Nacional, around 63 km away from the city of Palmas (north). The production unit has also a privileged location since it is nearby the Tocantins hydro road, as well as the north-south railroad. Both companies (Brasil Ecodiesel and Biotins Energia), albeit the obstacles regarding the management of family farmer production transportation, have a privileged logistics structure, especially regarding the biodiesel transportation to other states of the country, or even to other countries via Itaqui Port, located in the state of Maranhão (in the city of São Luis). The numerous ways of transport within the state, such as rivers and railroad, make Tocantins one "hot spot" for biodiesel production in Brazil.

4.5 Job generation

Apart from the social inclusion, another PNPB target is job generation. In this context, the present study also presents an analysis regarding the job generation fostered by the regional biodiesel production. The large-scale farming species, such as soybean and sunflower generates, on average, 0.05 jobs per hectare, against 0.5 in the case of *Ricinus* and *Jatropha*, for instance, both considered small-scale farming species. On average, soybean and sunflower

production requires 20 hectares to employ a family, against only 2 hectares in the case of *Ricinus* and *Jatropha* production.

Based on this, the number of current jobs, as well as the potential jobs that could be generated by the oil seed activities in Tocantins state, considering both the family and the business agriculture, were estimated. As mentioned previously, the current area occupied by *Jatropha curcas* in the state lies around 500 hectares, considering the family agriculture, and 4 thousand hectares considering the commercial agriculture. Thus, the small-scale *Jatropha* production is generating 250 jobs, on average, and the large-scale *Jatropha* production, for its turn, is generating 2 thousand jobs in Tocantins, on average. *Ricinus communis*, on the other hand, presents around 600 hectares occupied by small-scale farmers, which led to 300 jobs generated, on average. As *Ricinus* is not produced by large-scale farmers, there is no job generation from this vegetable oil, when one considers the business agriculture in Tocantins state. Roughly 95 thousand hectares of soybean, which represents 80% of raw/primary material used to produce biodiesel in the state, are responsible for generating 4,750 jobs in Tocantins, on average, i.e. if the soybean produced in Tocantins were used to produce biodiesel, it will generates almost 5 thousands of jobs. In summary, the area occupied by vegetable oil species in Tocantins state, sums over 100 thousand hectares, responsible for generating more than 7 thousand jobs. Nevertheless, there is an enormous potential for job generation in the state, especially regarding the family agriculture sector. Based on this, all the rural settlements within Tocantins were assessed and the potential of job generation was estimated.

Table 5: Job generation due to biodiesel production in Tocantins state

Items	Job/area	Vegetable oil			
		Soybean	*Ricinus*	*Jatropha*	Total
Family	Current area (ha)	-	600	500	1,100
	Jobs (n. persons)	-	300	250	550
Business	Current (ha)	95,000	-	4,000	99,000
	Jobs (n. persons)	4,750	-	2,000	6,750
Total area (ha)		95,000	600	4,500	100,100
Total jobs (n. persons)		4,750	300	2,250	7,300

Source: research results (2010).

So, first of all, a 125 km distance was established as the threshold for a rural settlement to be considered close to a biodiesel company. A settlement distant between 126 and 250 km from a biodiesel company was considered intermediary, and a rural settlement above 250 km from a biodiesel company was considered far away. The methodology applied in the present study is briefly demonstrated in Figure 8.

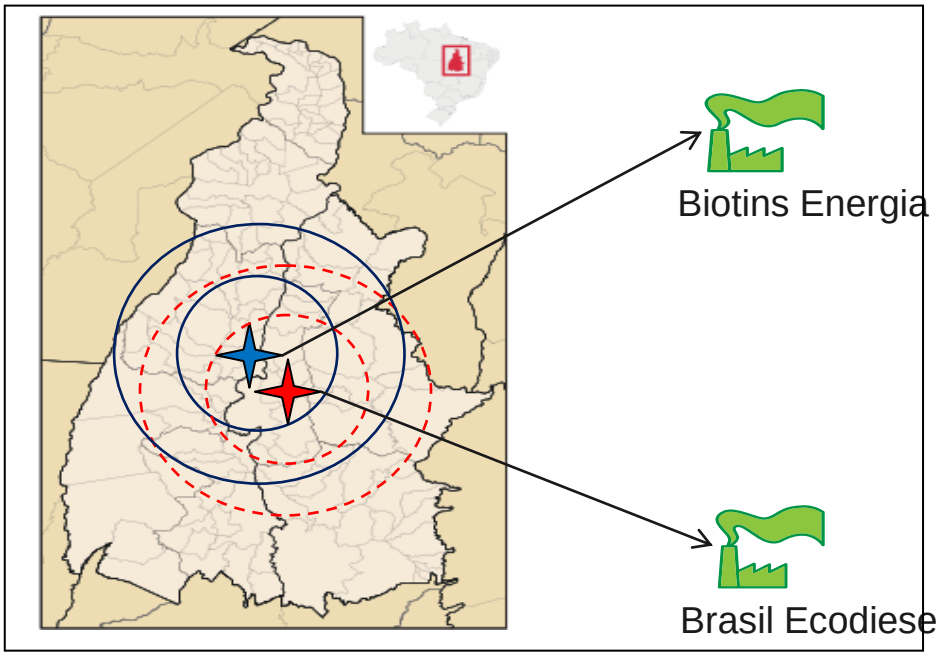


Figure 8: Distance from rural settlements to biodiesel companies in Tocantins state

So, following the methodology presented and depicted in Figure 8, all the rural settlements in Tocantins state were analyzed, regarding the distance from a biodiesel company. Based on this, as one can observe in the Table 6, around 1900 families are situated close to the Brasil Ecodiesel, and around 1600 families are close to the Biotins Energia. Thus, considering that the companies are aware about of the obstacles, such as the logistics, as well as transportation, one can be assured that more than 7 thousand hectares can be used to cultivate raw/primary material towards biodiesel production in the state, at a lower transportation and logistics costs. Moreover, considering the medium to high productivity of both *Jatropha curcas* and *Ricinus communis*, and including the remaining families that are located in an intermediary distance from the companies, one can conclude that the area needed to fulfill the 10% demand of raw/primary material from the family agriculture advocated by the PNPB and the SFS is successfully accomplished in Tocantins.

Table 6: Potential job generation and small-scale oil seed production in Tocantins state

Company	Distance to the biodiesel company		
	Near (<125km)	Intermediary (126-250km)	Far (>250km)
Brasil Ecodiesel			
- N. of rural settlements	44	47	138
- N. of families (potential producers)	1904	1465	6082
- Potential oil seed production (ha)	3808	3130	12164
Biotins Energia			
- N. of rural settlements	43	69	118
- N. of families (potential producers)	1604	3432	5036
- Potential oil seed production (ha)	3208	6864	10072

Source: own estimation based on INCRA (2010).

5. Final remarks

Based on the discussion mentioned above, one of the disadvantages of biodiesel production in Brazil, at the moment, is the non-diversification of vegetable oil species in the overall biodiesel production in the country. The distribution logistics appears to be a considerable constraint to the success of the Brazilian program of biodiesel use and production (PNPB). The concentration of biodiesel industries in the central-west region of the country, and the large distances to deliver biodiesel in the northern Brazil make biodiesel prices non-competitive when compared to fossil diesel. In addition, as the main transport means in the country are roads, lots of fossil diesel is used to transport biodiesel, and therefore not just the costs but also the energy balance of the renewable fuel becomes lower or even negative. A solution could be investments in new biodiesel industries in the northern region aiming at reducing the logistics costs. Another solution could be the regionalization of biodiesel blend targets, i.e. each region is responsible for implementing the mandatory percentage of biodiesel into fossil diesel aiming at minimizing the high distribution costs in a country with continental dimensions like Brazil.

In addition, the lack of an updated regulatory landmark about biodiesel production in Brazil is one of the main constraints to the sector growth. The different aliquots of ICMS throughout the country affect biodiesel producers, since it is difficult to compete with industries located in one region with better ICMS aliquots. Another important issue regarding the PNPB constraints is the commercialization of biodiesel. National auctions were an essential instrument to initialize the biodiesel market in Brazil, but at the moment the free market might be the best way to fit demand and supply equilibrium. In this context, distributors could start to purchase directly from industries and not anymore from Petrobras, the only buyer at national auctions characterizing therefore a pure monopsony situation. Industries with lower transport and production costs will have advantages and ANP will, step by step, be out of the control of the biodiesel production and distribution chain in Brazil. In future, national auctions should use into CIE (Cost Insurance Freight) rather than FOB (Free on Board) methods.

Although Brazil has vocation to produce renewable energy, the country still does not present a scale that guarantees sustainability to the PNPB. At the same time, relying only on alternative crops such as *Ricinus communis* or *Jatopha curcas*, to increase in the mandatory biodiesel blend into fossil diesel, might jeopardize the entire program. On the other hand, the availability of soybean oil depends on international markets, and thus an increase in the price at these markets makes biodiesel in the country less competitive. A similar situation occurred in the year of 2008, when soybean prices had a boom and all the entire biodiesel chain in Brazil had their selling margins squeezed. Biodiesel produced from *Ricinus*, for instance, quoted at market prices, costs 23% more than the same raw/primary material obtained at production costs, i.e. *Ricinus* produced by the biodiesel industry has more economic advantages compared to *Ricinus* bought at the market. Based on this, one solution could be the integrated/vertical industry, which comprises the agricultural and industrial sector, considered essential to the competitiveness of the biodiesel sector. Considering that 80% of total biodiesel costs are related to raw/primary material, the vertical cluster is a new process for this sector. In this context, one should expect that industries that also extract oil might have a higher share at the national and international biodiesel market. Nevertheless, one should bear in mind that an extraction unit corresponds to large investments, apart from the entire adequacy to a new business model.

The adverse effect of soybean dependency is not just related to raw/primary material supply, since Brazil possesses a large area cultivated with this vegetable oil (soybean is the most produced crop in Brazil). There is a risk of soybean shortage to produce biodiesel if the mandatory blend reaches 8% (B8) Moreover, the low productivity of soybean as a vegetable oil (only 18% of each grain can be used to produce oil) can impact the market of bran and animal feed, since more soybeans should be cultivated to fulfill the B8 target. In addition, some countries can also create trade barriers to biodiesel produced from soybean due to the food versus feed debate. In addition, as soybean is dominating as the primary material for biodiesel, it indicates the weakness in the environmental sustainability of the PNPB, since soybean is an oil crop cultivated on large-scale, as well as monoculture, which requires the clearing of extensive areas of land and the eventual loss of biodiversity. The predominance of soybean may also jeopardize the social and energy targets of the PNPB since job creation through soybean production has been estimated to be over manifold smaller than *Ricinus communis* (castor) in Brazil, for instance.

Regarding the regional analysis of biodiesel production, one of the results present hitherto suggest that the PNPB is not succeeding in promoting the integration of family agriculture in the Tocantins state, especially because of the structural difficulty of the agricultural sector and the technical and political shortcomings presented by the mechanism of incentives. Thus, if the PNPB does not comprise amendments and adjusts that really favor the small-scale family famers, the biodiesel production in Tocantins state and in Brazil as a whole will follow the same path of ethanol production, i.e. the production will be focused on just one raw/primary material which demands large-scale processing units, as well as is centralized in one region of the country.

O PROGRAMA BRASILEIRO DE BIODIESEL E DESENVOLVIMENTO REGIONAL: CASOS NO NORTE DO BRASIL

RESUMO

A produção de biocombustíveis tem sido amplamente debatida no Brasil, o que levou o país a desenvolver e a implantar, no ano de 2004, o Programa nacional de produção e uso de biodiesel (PNPB), com a intenção de aumentar a participação de energias renováveis na matriz energética brasileira e, ao mesmo tempo, promover o desenvolvimento regional. Neste contexto, o presente estudo visa avaliar os impactos do PNPB no desenvolvimento regional do Estado do Tocantins, no norte do Brasil. Para isto, uma gama de indicadores sócio-econômicos foram coletados entre os órgãos responsáveis, em nível nacional e regional, bem como na literatura específica. Os resultados preliminares apontam que a logística de distribuição parece ser um obstáculo considerável para o sucesso do PNPB. A concentração de indústrias de biodiesel na região centro-oeste do país, e as grandes distâncias para entregar o biodiesel no norte do Brasil, torna o preço do biodiesel não competitivo quando comparado com o diesel fóssil. Os resultados também sugerem que o PNPB não está conseguindo promover a integração da agricultura familiar no estado do Tocantins, especialmente por causa da dificuldade estrutural do setor agrícola e as deficiências técnicas e políticas apresentadas pelo mecanismo de incentivos.

Palavras-chave: biodiesel; desenvolvimento regional; Tocantins

REFERENCES

ANP (National Agency of oil, natural gas and biofuels). 2010. Biodiesel statistics. Available at www.anp.gov.br (verified 10 March 2010).

BARROS, G. S. *et al*. Custos de produção de biodiesel no Brasil. 2006. Revista de Política Agrícola n.3, Brasilia, DF.

BELTRÃO, N. E. *et al*. O cultivo sustentável da mamona no semi-árido brasileiro. 2006. Available at http://www.cnpq.embrapa.br (verified 10 October 2009).

BIODIESEBR. Biodiesel statistics. 2009. Available at http://www.biodieselbr.com (verified 12 December 2009 and 23 April 2010).

BIODIESEBR. Biodiesel statistics. 2010. Available at http://www.biodieselbr.com (verified 12 December 2009 and 23 April 2010).

BRAZIL. Biodiesel statistics. 2004. Available at http://www.biodiesel.gov.br/ (verified 17 November 2009).

DUBOIS, O. How Good Enough Biofuel Governance Can Help Rural Livelihoods: Making sure that Biofuel Development Works for Small Farmers and Communities. 2008. FAO, Rome, Italy.

EBB (European Biodiesel Board). 2010. Available at http://www.ebb-eu.org/ (verified 13 May 2010).

EIA (U.S. Energy Informational Administration). 2010. Available at http://www.eia.doe.gov/ (verified 13 April 2010.

EPE (Enterprise in Energy Research). Ministry of Mines and Energy, Brazil. 2009. Available at http://www.epe.gov.br/Paginas/default.aspx (verified 19 November 2009).

FAO (Food and Agriculture Organization of the United Nations). Bioenergy, food security and Sustainability – Towards an International Framework. 2008a. Available at http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-3-E.pdf (verified 26 October 2009). FAO, Rome, Italy.

FAO (Food and Agriculture Organization of the United Nations). Climate Change, Bioenergy and Food Security: Civil Society and Private Sector Perspectives. 2008b. Available at http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-6-E.pdf (verified 26 October 2009). FAO, Rome, Italy.

FAO (Food and Agriculture Organization of the United Nations). Climate Change, Bioenergy and Food Security: Options for Decision Makers identified by Expert Meetings. 2008c. Available at http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-5-E.pdf (verified 26 October 2009). FAO, Rome, Italy.

FAOSTAT. 2009. Available at http://www.fao.org (verified 15 September 2009).

FINCO, M. V. A.; RODRIGUES, W.; RODRIGUES, I. The Brazilian Amazon and Carbon Credit Market: Perspectives for the State of Tocantins. 2006. Amazônia, Ciência e Desenvolvimento. pp.7-24.

GARCEZ, C. A. G.; VIANNA, J. N. S. Brazilian Biodiesel Policy: Social and environmental considerations. 2009. Energy. doi: 10.1016/j.energy.2008.11.005.

GARCIA, J. R. O Programa Nacional de produção e uso de biodiesel brasileiro e a agricultura familiar na região nordeste. 2007. Dissertação de mestrado. Instituto de Economia (UNICAMP).

GTI (Interdeparmental work group). 2003. Available at http://www.biodiesel.gov.br/docs/anexo2.pdf (verified 10 october 2009).

HOLANDA, A. O biodiesel e a inclusão social. 2003. Available at http://www.sfiesc.org.br/artigos/tecnologia/BIODIESEL_2003.pdf (verified 12 September 2009).

INCRA (Brazilian Institute of Agrarian Reform and Colonization). 2010. Available at http://www.incra.gov.br/portal/ (verified 15 March 2010).

MDA (Ministry of Agrarian Development). 2005. Available at http://www.mda.gov.br/saf/index.php?sccid=353 (verified 26 October 2009).

MDA (Ministry of Agrarian Development). 2010. Available at http://www.mda.gov.br/saf/index.php?sccid=353 (verified 11 February 2010).

MEIRELLES SALES, F. Viabilidade de utilização de óleo vegetal. 2003. Available at http://www.faespsenar.com.br (verified 18 November 2009).

MME (Ministry of Mines and Energy). 2004. Available at http://www.mme.gov.br/mme (verified 12 November 2009).

MME (Ministry of Mines and Energy). 2006. Available at http://www.mme.gov.br/mme (verified 12 November 2009).

NAPPO, M. Biodiesel no Brasil: a visão da indústria de óleos vegetais. 2006. Available at http://www.abiove.com.br (verified 14 October 2009).

NASS, L.; PEREIRA, P.; ELLIS, D. Biofuels in Brazil: An Overview. 2007. Crop Science, vol. 47.

PNPB. 2005. Programa Nacional de Produção e Uso de Biodiesel. www.biodiesel.gov.br/programa.html.

SEAGRO (Secretary of Agriculture, Livestock and Food Supply of Tocantins State). 2009. Available at http://www.seagro.to.gov.br/ (verified 18 December 2009).

UN-Energy. Sustainable Bioenergy: A Framework for Decision Makers. 2007. Available at http://www.fao.org/docrep/010/a1094e/a1094e00.htm (verified at 26 October 2009).

VARIAN, H. R. Intermediate microeconomics. A modern approach. 2006. Sixth edition.

YAMAOKA *et al*. Programa paranense de Bioenergia. 2003. Available at http://www.iapar.br/iapar_xoops/arquivos/File/bioenergia.pdf (verified 21 November 2009).